LIQUID LEVEL INDICATOR USING LIGHTS

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Liquid Level Indicator Using Lights

Background of the Invention

[0001] It is known to indicate the level of liquid in a tank or reservoir with mechanical flags. A magnet or magnet assembly is movable up and down with the level of liquid in the tank. As the level of liquid in the tank drops, the magnet moves down alongside the column of flags, which extends for the entire height of the tank. As the magnet passes the flags, it causes the flags to turn, one by one, from a light color to a dark color (or vice versa). Thus, the overall appearance of the column gradually changes, providing an indication of the vertical location of the magnet. The appearance of the column provides an indication of the level of the liquid in the tank. One drawback to this type of level indicator is that it is not inherently visible in darkness. In addition, it includes numerous moving parts (the mechanical flags) that, over time, might stick or lock up.

[0002] It is also known to indicate the level of liquid in a tank or reservoir by moving a magnet along a column of individually actuatable, non-latching reed switches. The reed switches are associated in a one-to-one relationship with a column of resistors in series. The resistors are electrically connected with remote electrical circuitry. As the level of liquid in the tank drops, the magnet moves down alongside the column of reed switches. As the magnet passes the reed switches, it causes the reed switches to close, one by one, gradually increasing the overall resistance of the column of resistors. The resistance is sensed by the remote electric circuitry to provide an indication, on a display, of the vertical

location of the magnet. The sensed resistance provides an indication to a computer of the level of the liquid in the tank.

Summary of the Invention

[0003] The present invention relates to a liquid level indicator assembly and to a method of indicating the level of liquid in a tank. The indicator assembly includes one or more columns of lights that are turned on or off as the level of liquid in the tank rises and falls. The lights may be turned on and off by the passage of a magnetic float that changes the state of magnetically actuatable switches, such as Hall effect transistors, that are associated in a one-to-one relationship with the lights. If two columns of lights are used, they may be of different colors, so that the overall appearance of the assembly changes color, for example, from red to green.

Brief Description of the Drawings

[0004] The foregoing and other features of the present invention will become apparent to one skilled in the art to which the present invention relates upon consideration of the following description of the invention with reference to the accompanying drawings, in which:

[0005] Fig. 1 is a schematic view of a liquid level indicator assembly associated with a tank containing liquid;

[0006] Fig. 2 is an enlarged schematic view of a portion of the indicator assembly of Fig. 1 associated with the tank and a gauge assembly;

[0007] Fig. 3 is a schematic front elevational view of a portion of the indicator assembly showing several rows of lights that form part of the indicator assembly;

[0008] Fig. 4 is a schematic rear elevational view of a portion of the indicator assembly showing several rows of switches that form part of the indicator assembly;

[0009] Fig. 5 is an electrical schematic diagram of a portion of the indicator assembly;

[0010] Fig. 6 is a view similar to Fig. 3 of a portion of an indicator assembly constructed in accordance with a second embodiment of the invention;

[0011] Fig. 7 is a schematic rear elevational view of a portion of the indicator assembly of Fig. 6; and

[0012] Fig. 8 is an electrical schematic diagram of a portion of the indicator assembly of Fig. 6.

Description of the Invention

[0013] The present invention relates to an indicator assembly for indicating the level of liquid in a tank. The invention is applicable to indicator assemblies of varying constructions. As representative of the invention, Figs. 1-5 illustrate an indicator assembly 10 that is constructed in accordance with a first embodiment of the invention.

[0014] The indicator assembly as illustrated is used for indicating the level of liquid in a tank, such as the tank shown schematically at 12. The tank 12 has a side wall 14. The liquid level in the tank shown in Fig. 1 is indicated by the line 16. The indicator assembly 10 is usable with other types of tanks or reservoirs or liquid containers than that shown.

[0015] A gauge assembly 20 is mounted on the tank side wall 12. The gauge assembly 20 may be of one of the types shown in U.S. Patents 5,647,656;

5,645,336; and 5,743,137, the disclosures of which are incorporated herein by reference. The gauge assembly 20 as illustrated includes a cylinder 22 containing liquid 24. The level of the liquid 24 in the cylinder 22 varies with the liquid level 16 in the tank 12.

[0016] A float 26 is suspended in the liquid 24 in the cylinder 22 and rises and falls with the liquid level in the cylinder 22. The level of the float 26 thus indicates the liquid level 16 in the tank 12. The float 26 carries a magnet or magnet assembly that produces a magnetic field, indicated schematically at 28.

[0017] The indicator assembly 10 is supported adjacent the gauge assembly 20. The indicator assembly 10 includes a substrate or base 30. In one embodiment, the indicator assembly 10 is formed as a printed circuit assembly with components mounted on a suitable circuit board as the base 30.

[0018] Two columns of lights are mounted on the base 30. The two columns include a first column 32 including a plurality of lights 34, and a second column 36 including a plurality of lights 38. The lights 34 and 38 are preferably LED's, but could be another type of light. When the indicator assembly 30 is in use it is mounted so that the columns 32 and 36 extend vertically alongside the gauge assembly 20.

[0019] The lights in the two columns 32 and 36 are of different colors when energized. In the illustrated embodiment, the lights 34 in the first column 32 are red LED's, and the lights 38 in the second column 36 are green LEDs.

[0020] Also mounted on the base 30 of the indicator assembly are a plurality of magnetically actuated switches 40 that are electrically connected with the lights 34 and 38 in a circuit 42 as described below. A plurality of resistors 44 are also mounted on the base 30 and are electrically connected with the switches 40 and the lights 34 and 38 in the circuit 42 as described below.

[0021] The switches 40 are preferably Hall effect transistors. Hall effect transistors are preferred because they are activated by such a magnetic field, they are less expensive than reed switches, and are more durable thermally, electrically, and physically. The Hall effect transistors could, alternatively, be replaced another type of switch 40, such as a reed switch, which can be switched by the particular level of magnetic force that is generated by the gauge assembly 26. One commercial gauge assembly 20 generates approximately 120 gauss in the plane of the switches 40.

[0022] As shown schematically in Figs. 4 and 5, the circuit 42 on the board 30 includes a plurality or series of "cells" 50 each of which includes two lights 34 and 38, a transistor 40, and two resistors 44. The two lights 34 and 38 are connected with one terminal of the transistor 40. The one terminal is also connected to a positive bus 46 on the base 30.

[0023] The red light 34 is connected in series with one resistor 44 to a second terminal of the transistor 40. The green light 38 is connected in series with the other resistor 44 to a third terminal of the transistor 40. A fourth terminal of the transistor 40 is connected to a negative bus 48 on the base 30.

[0024] A remote readout, indicated schematically at 50, is electrically connected with the indicator assembly 10. The remote readout 50 can be a series of lights, or a gauge, or a computer system, for example, located in a building or room that is adjacent to or remote from the actual tank 12.

[0025] As the liquid level 16 in the tank 12 rises and falls, the level of the liquid 24 in the cylinder 22 also rises and falls. The float 26 moves with the liquid level in the cylinder 22, that is, in response to rising or falling liquid level 16 in the tank 12. As the float 26 moves, the magnetic field 28 that it produces moves vertically along the length of the indicator assembly 10.

[0026] When the indicator assembly 10 is first powered up, all the Hall effect transistors 40 are in steady state closed output. As a result, all the red lights 32 are energized (assuming no magnetic field is present at the location of the transistors 40).

[0027] As the float 26 rises or falls, it actuates serially the switches 40. Specifically, as the float 26 rises past each transistor 40, the magnetic field 28 of the moving float causes, in response, a small current to be generated within each transistor that the field passes. This current switches the output of the transistor 40 so that the open output closes and the closed output opens. In response, the red light 32 is de-energized and the green light 36 is energized.

[0028] Thus, as the float 26 and its magnetic field 28 move upward along the length of the indicator assembly 10, past the levels indicated by the pairs of associated red and green lights 32 and 36, the red light 32 at each level is replaced with a green light 36. As a result, in the indicator assembly 10 one and only one member of each pair of lights 32 and 36 is illuminated.

[0029] The transistors 40 are latching devices. Therefore, when the magnetic field 28 moves away from a transistor 40, the transistor maintains its state until another, subsequent, magnetic force causes it to switch back to its previous state. Thus, when a red light 32 is turned on or off, it maintains that state, and when a green light 36 is turned on or off, it also maintains that state.

[0030] As a result, the level of liquid 16 in the tank 12 is visible external to the tank 12, in a self-illuminated manner that can be seen in the dark. In addition, the remote readout 50 can indicate remotely the level of liquid 16 in the tank 12. Thus, the level of liquid 16 in the tank 12 can be read both at the tank itself, near (within visible range) of the tank, and at any distance over which an electrical signal can be sent.

[0031] Figs. 6-8 illustrate an indicator assembly 10a that is constructed in accordance with a second embodiment of the invention. Parts of the indicator assembly 10a that are the same as or similar to parts of the indicator assembly 10 (Figs. 1-5) are given the same reference numerals with the suffix "a" attached.

[0032] The indicator assembly 10a includes only one column 60 of lights 62 mounted on the base 30a. The lights 62 are preferably LED's arranged in rows, with only one LED in each row. All the lights 62 are preferably of the same color, and could be, for example, white when illuminated. When the indicator assembly 10a is in use it is mounted so that the column 60 of lights 62 extends vertically alongside a gauge assembly.

[0033] Also mounted on the base 30a of the indicator assembly 10a are a plurality or series of magnetically actuated switches 40a that are electrically interconnected with the lights 62 as described below. As in the first embodiment, the switches 40a are preferably Hall effect transistors. A plurality or series of resistors 44a are also mounted on the base 30 in a one-to-one relationship with the switches 40a and the lights 62.

[0034] As shown schematically in Figs. 7 and 8, the circuit 42a on the board 30a includes a plurality or series of "cells" 50a each of which includes one light 62, a transistor 40a, and one resistor 44a. The light 62 is connected with one terminal of the transistor 40a that is connected to a positive bus 46a on the base 30a. The light 62 is connected in series with the resistor 44a to a second terminal of the transistor 40a. A third terminal of the transistor is connected to a negative bus 48a on the base 30a. A remote readout (not shown) may also be electrically connected with the indicator assembly 10a.

[0035] The indicator assembly 10a is associated in operation with a tank 12 and a gauge assembly 20 as in the first embodiment of the invention. When the

indicator assembly 10a is first powered up, all the Hall effect transistors 40a are in steady state closed output. As a result, all the lights 62 are energized (assuming no magnetic field is present at the location of the transistors 40a).

[0036] As the float 26 rises or falls, it actuates serially the switches 40a. Specifically, as the float 26 falls past each transistor 40a, the magnetic field 28 of the moving float causes, in response, a small current to be generated within each transistor that the field passes. This current switches the outputs of the transistor 40a, and in response, the light 62 associated with the transistor is de-energized (turned off).

[0037] Thus, as the float 26 and its magnetic field 28 move downward along the length of the indicator assembly 10a, past the levels indicated by the lights 62, the energized light at each level is replaced with a de-energized light. When the magnetic field 28 moves away from a transistor 40a, the associated light 62 maintains its on or off state until a subsequent magnetic field switches the transistor. As a result, the indicator assembly 10a provides an indication of the level of liquid in the tank 12 which is visible external to the tank, in a self-illuminated manner, that can be seen in the dark. In addition, the level of liquid in the tank 12 can be read remotely, as above, if desired.

[0038] From the above description of the invention, those skilled in the art will perceive improvements, changes, and modifications in the invention. For example, each row of lights could include more than two lights, and a remote readout need not be used. Such improvements, changes, and modifications within the skill of the art are intended to be included within the scope of the appended claims.